REMARKS

Status of the Claims

Claims 1, 3, 4, 8-9, 11-15, 36-38, 40-41, 43-47 and 50-55 are currently pending in the present application.

Amendments

Claim 5 has been canceled. Claims 1, 46, 51, 52, 54 and 55 have been amended to specify that the purified purge gas comprising oxygen (O_2) and water has an AMC concentration less than about 1 part per trillion (ppt). This amendment is supported by U.S. Provisional Application No. 60/475,145, for example, at the abstract. Claims 1, 46, 51, 52, 54 and 55 have also been amended to specify that the method includes the step of outgassing AMC from the surface of the contaminated substrate. This amendment is supported by the specification, for example, at pages 6 and 9. Claims 1 and 54 were amended to refer to "the purified purge gas."

Rejection under 35 U.S.C. § 112, first paragraph

Claims 53 and 55 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The Examiner stated that the limitations of the claims constitute new matter not supported by the originally filed specification.

With regard to claim 53, the Examiner stated that the claim is not supported by Example 6 because the claim is directed to outgassing by contacting with a purified purge gas comprising O_2 and water, but Example 6 is directed to XCDA and not molecular oxygen and water, and the XCDA is purified and does not include any teaching of adding water.

With regard to satisfying the written description requirement, the fundamental factual inquiry is "whether the specification conveys with reasonable clarity to those skilled in the art that, as of the filing date sought, applicant was in possession of the invention as now claimed." MPEP 2613 (I)(B). A person of ordinary skill in the art would have known that XCDA, which stands for eXtreme Clean Dry Air, includes dioxygen, since it is well known that the general composition of air is approximately 21% O_2 and 78% N_2 by volume, with the remainder

including trace amounts of other elements and compounds (http://www.engineeringtoolbox.com/air-composition-d_212.html, attached hereto).

Regarding water, although Example 6 is directed to XCDA, the provisional specification teaches humidifying XCDA. Specifically, page 14 of U.S. Provisional Application No. 60/475,145, which states "[t]he XCDA may be passed through a bubbler containing UHP water," and page 15, which states "[i]t is possible to add a bubbler or other wetting device for dry XCDA gas...therefore you dry the XCDA and then remoisturize it with ultrapure H_2O..." Therefore, it would have been clear to a person of ordinary skill in the art that Applicants were in possession of the invention as claimed in claim 53.

Reconsideration and withdrawal of the rejection are therefore respectfully requested.

With regard to claim 55, the Examiner stated that the claim is not supported because pages 11-13 fails to teach dehumidifying the purified purge gas comprising oxygen, then adding a controlled amount of water to the dehumidified purge gas. Applicants direct the Examiner's attention to pages 14 and 15 of U.S. Provisional Application No. 60/475,145, as described immediately above. The priority application teaches drying the XCDA and then remoisturizing it using a bubbler, which provides for the controlled addition of water to the XCDA. Therefore, it would have been clear to a person of ordinary skill in the art that Applicants were in possession of the invention as claimed in claim 55.

Reconsideration and withdrawal of the rejection are therefore respectfully requested.

Rejection under 35 U.S.C. § 112, second paragraph

Claim 53 was rejected under 35 U.S.C. § 112, second paragraph, as being indefinite because it is unclear how the outgassing rate can be expressed as a concentration value of 1ppt or less. The specification refers to outgassing rates in terms of ppt (for example, page 24, line 15 of the present specification and page 9 of Provisional Application No. 60/475,145). As used in the context of the present specification and as would be understood by a person of ordinary skill in the art, the language "outgas from the surface at a rate at or below 1 ppt" means that for every trillion parts of the purge gas provided, one part or less of the organic contaminant outgasses from the surface of the substrate. Thus, parts per trillion is used to refer to both a concentration

and a rate of outgassing. Claims 53 therefore meets the requirements of 35 U.S.C. § 112, second paragraph. Reconsideration and withdrawal of the rejection are respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 1, 3-5, 8-9, 11, 38, 41, 43-47 and 53-54 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,427,703 (hereinafter, "Somekh") in view of U.S. Patent No. 6,610,123 (hereinafter "Wu") and further in view of U.S. Patent No. 6,391,090 (hereinafter, "Alvarez").

The presently claimed invention is directed to outgassing AMC from a surface of the substrate using a purified purge gas comprising oxygen (O_2) and water. Historically, inert purge gases of high purity have been used to purge equipment surfaces of absorbed contaminants. Specifically, conventional wisdom in the art has taught that gases such as ultra high purity (UHP) nitrogen are needed to remove surface impurities (pg. 8, lines 26-28 of the present application). In addition, oxygen and water have long been considered to be impurities that must be removed from equipment surfaces (pg. 11, lines 14-15 of the present application). Therefore, gases containing oxygen and/or water were considered inappropriate for cleaning of equipment components.

The inventors of the present invention made two important discoveries: 1) large amounts of absorbed contaminants can be trapped under equipment surfaces, surprisingly more than originally thought; and 2) contrary to conventional wisdom, the purge gases used in the presently claimed method are capable of desorbing contaminants from equipment surfaces more efficiently than nitrogen. These discoveries are significant, because thorough desorption of contaminants from equipment surfaces can greatly improve product yield and because purge gases comprising oxygen and/or water are safer and less expensive than nitrogen, and they can be produced on site.

The surprising extent to which contaminants are present as absorbed species within equipment and the effectiveness of an oxygen-containing purge gas in effecting their removal by outgassing are demonstrated, for example, in Example 1 and Fig. 9. of the present application. In the example, a contaminated gas containing hydrocarbons was introduced in a wafer chamber to achieve a known level of contamination therein. Two purge gases, UHP nitrogen purge and an oxygen-containing purge gas (extra clean dry air, or XCDA), were used to purge the wafer

chamber and the effectiveness of each was compared. Fig. 9 shows the reduction of hydrocarbon contaminant concentration over time for both purge gases. The oxygen-containing purge gas is represented by line 608, while the nitrogen purge gas is represented by line 606. For both nitrogen and XCDA, the elution times required to achieve a concentration of 10 ppt was greater than six hours (about 6 hours and 20 minutes for XCDA, and about 7 hours for nitrogen), but the theoretical elution time was calculated to be only less than 20 minutes (page 16, lines 20-27). This indicated that most of the contaminants were desorbed contaminants from the surface of the wafer chamber rather than contaminants present in the gas within the chamber. The examples also established that XCDA achieved desorption of the contaminants from the wafer chamber interior surface over a shorter period of time than nitrogen. Similar results are achieved using water-containing purge gases, such as nitrogen and water, and XCDA and water, as demonstrated in Example 5 and Table 1.

In contrast, Somekh discloses carbon deposits from equipment by reacting the carbon deposits to form a volatile gas species. (See Somekh col. 3, lines 13-45.) Somekh explains that repeated exposure of a mask to charged particle beams tends to cause a build-up of carbon on the mask (col. 1, lines 61-67). To eliminate the carbon deposits, Somekh discloses transforming the surface carbon deposits into an oxidized carbon gas, namely carbon monoxide (CO) and carbon dioxide (CO_2) (col. 5, lines 34-41). Somekh discloses providing an oxidizer in an activated state using methods such as thermal activation, microwave activation, plasma discharge, and ozone activation (col. 6, lines 38- 45) to chemically transform the carbon deposits into CO and CO_2 and subsequently removing the different gaseous entities (col. 5, lines 33-40).

In determining the differences between the prior art and the claims, the question under 35 U.S.C. § 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. MPEP 2141.02 (I). As a whole, the presently claimed invention is directed to a process of outgassing AMC by contacting at least a portion of the substrate with a purified purge gas. According to the Oxford English Dictionary, the term "outgas" means "to drive off sorbed gas or vapour from a solid" (definition attached hereto). The carbon contamination on the mask as described by Somekh are solid "deposits," and not AMC absorbed at the mask surface. Therefore, Somekh does not disclose outgassing the AMC from a surface of the organic contaminated substrate, as presently claimed.

Further, Applicants maintain that Wu fails to disclose the presently recited temperature ranges. In response to the Applicants' previous argument that the term "ambient," as described in the disclosure of Wu at column 3, lines 1-4, does not amount to a teaching or suggestion of "contacting at least a portion of the substrate with a purified purge gas at a temperature of about 20-100°C," the Examiner reiterated the language provided in Wu, which states:

> The temperature set point is usually chosen to be the same as the ambient temperature in the vicinity of the mask 240 in the stepper. The temperature of the purge gas 215 is controlled to +/-0.2 degree Centrigrade. (Emphasis added)

The Compact Oxford English Dictionary (Second Edition) provides the following non-rare (note that entries 1, 2, 5 and 6 are denoted as being rare) definitions of ambient (entries are attached hereto):

> 3. Lying round, surrounding, encircling, encompassing, environing.
>
> 4. Surrounding as a fluid; circumfused.

Thus, as stated previously in the context of Wu, the term "ambient" refers to the temperature of the fluid surrounding the mask in the stepper, not any particular numerical temperature value.

In further support of Applicants' position, Wu specifically states "...ambient temperature in the vicinity of the mask." If the above statement were intended to mean that the temperature set point is chosen to be ambient/room temperature, as suggested by the Examiner, Wu would simply have stated "The temperature set point is usually chosen to be ambient temperature."

The Examiner further stated that it is well known in the cleaning art, as evidence by U.S. Patent No. 4,276,368 of Heller *et al.* ("Heller") that ambient temperature refers to room temperature.

Applicants respectfully disagree that Heller evidences that ambient temperature necessarily means room temperature. At col. 8, lines 7-9, Heller states:

> Examples were generally conducted with development carried out at ambient temperature (room temperature).

If it were indeed well understood in the cleaning art that ambient temperature refers to room temperature, as suggested by the Examiner, it would not have been necessary for Heller to

parenthetically clarify that the term ambient, for the purposes of that particular disclosure, means "room temperature."

Applicant's own priority application, Provisional Application No. 60/475,145, also parenthetically clarifies what is meant by "ambient," as that word is used in the Provisional Application (page 14 of Provisional Application No. 60/475,145)[1]. Thus, the reference does not provide a specific temperature, much less the specific temperature range of about 20 to 100°C.

The Examiner indicated at paragraph 17 of the Office Action that the Examiner's hindsight is proper because the application of the temperature range of about 20 to 100°C of Somekh was within the level of ordinary skill at the time the invention was made and does not include knowledge gleaned only from the applicant's disclosure. As stated previously, Wu does not teach the presently claimed temperature range of about 20 to 100°C and Applicants are unable to find any such teaching within the Examiner's cited prior art. Therefore, the Examiner's hindsight is improper.

In response to Applicants' argument that a person of ordinary skill in the art would not combine Somekh and Wu because high temperatures are required to carry out the method of Somekh, as evidence by Exhibits A and B, the Examiner indicated at paragraph 18 of the Office Action that the Exhibits A and B are not persuasive because they are directed to different methodologies that are "unrelated to the photolithographic process and a purge gas." However, it is irrelevant that Exhibits A and B are unrelated to a photolithographic process and purge gas. Applicants submitted these exhibits to establish the temperature range required to oxidize carbon. The reaction temperatures demonstrated in Exhibits A and B are parameters of general chemical reactions in which carbon undergoes oxidation; the behavior of chemical reaction itself is independent of the particular application in which the chemical reaction is being used.

Additionally, Applicants note that U.S. 5,786,042 of Inoue *et al.* (Inoue), which the Examiner has cited as evidence that carbon is oxidized at room temperature (asserted by the Examiner at page 13, paragraph 18 of the Office Action), also is not related to a photolithographic process. Applicants further note that Inoue does not actually state that carbon

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[1] The first full paragraph on page 14 of Provisional Application No. 60/475,145 states:

> Purification and cleaning of components and apparatuses is preferably carried out at temperature between ambient temperatures (about 20°C) to about 50°C. (Emphasis added).

powder is oxidized by dioxygen (O_2) at room temperature, but merely states that carbon black can be kept at a pH of 6.5 or less by bringing carbon powder into contact with free (i.e., not chemically bound in a molecule) oxygen at room temperature (col.2, lines 55-59).

Reconsideration and withdrawal of the rejection are therefore respectfully requested.

Claims 14-15, 40 and 50 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Somekh in view of Wu and Alvarez as applied above, and further in view of U.S. Patent No. 6,724,460 of Van Schaik ("Van Schaik").

The Examiner asserts that Van Schaik teaches purging with nitrogen and that it would have been obvious to a person of ordinary skill in the art to have modified the method of Somekh to include purging with an inert gas. With regard to claim 40, the Examiner states the Van Schaik teaches 20% of oxygen.

Claims 14, 15, and 50 are directed to purging the substrate with an inert gas to remove at least one of oxygen and water after removing the contaminated purge gas from the substrate, not merely purging with nitrogen. As stated in the present application at page 13, lines 24-30:

> ...an oxygen and water containing purge gas...is removed by purging with a dry gas including...nitrogen or other inert gas to remove the water, which is incompatible with a number of high purity applications...an oxygen containing purge gas is removed by purging with nitrogen or another inert gas, if the device is to be placed into service where oxygen is considered undesirable.

That is, an inert purge gas is used to purge a system of the presently claimed purge gas comprising oxygen and water in order to remove said latter purge gas after outgassing AMC from contaminated surfaces, when its presence in the system may be no longer considered desirable.

Van Schaik fails to teach or suggest purging the substrate with an inert gas after removing the contaminated purge gas from the substrate. Thus, in addition to the reasons stated above with respect to Somekh and Wu, claims 14, 15, and 50 are patentable over the Examiner's cited references.

With regard to claim 40, the Examiner stated that Van Schaik teaches 20% of oxygen at col. 9, lines 40-45. Actually, col. 9, lines 40-45 of Van Schaik teaches "20% of an oxygen-

containing species" (Emphasis added), which the reference defines as water, nitrogen oxide, and oxygen-containing hydrocarbons" (col. 4, lines 6-8). In any case, the reference fails to specify whether the 20% is weight basis, molar basis, or volumetric basis. Therefore, this reference fails to teach "wherein the purified purge gas comprises oxygen at a concentration between about 1% and 25% on a volume basis," as recited in claim 40 of the present application.

Reconsideration and withdrawal of the rejection are therefore respectfully requested.

Claims 1, 3-5, 8-9, 11, 38, 40-41, 43-47 and 51-54 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Application Publication No. 2005/0017198 of Van Der Net ("Van Der Net") in view of Alvarez.

Applicants respectfully disagree with the Examiner's position at page 14, paragraph 20 of the Office Action, that the claimed invention is not supported by the provisional application, and therefore the effective filing date of the instantly claimed invention is 10/10/03, after the filing date of Van Der Net.

The present claims are supported by the specification. For example, regarding claim 1:

Claim Element	**Support from Provisional Application No. 60/475,145**
outgassing the AMC from a surface of the organic contaminated substrate	Pages 6 and 7 – 2.2. Procedure describes outgassing of contaminated valves
by contacting at least a portion of the substrate with a purified purge gas	Page 6 – "Purified sample case (N2 and CDA) was sent through each VUT..." Page 7 – "The purge gas was then changed to XCDA. The sample purge procedure was then repated for each of the previously nitrogen purged VUT."
at a temperature of about 20 °C to 100 °C	Page 14 – "Purification and cleaning of components and apparatuses is preferably carried out temperature between ambient temperatures (about 20°C) to about 50°C. Cleaning may be carried out at high temperatures, up to 100°C or even 150°C."
the purified purge gas comprising oxygen (O_2) and water,	Page 15 - "[i]t is possible to add a bubbler or other wetting device for dry XCDA gas...therefore you dry the XCDA and then

	remoisturize it with ultrapure H2O..."
the purified purge gas having an AMC concentration less than about 1 part per trillion (ppt) on a volume basis,	Page 1 – The effects of AMCs have been previously studied...some common contaminants and their effects...are shown in Table 1. Table 1 Page 2 – "XCDA is the result of polishing readily available clean dry air to contain less than 1 ppt per species for non-methane hydrocarbons, sulfur compounds, and siloxanes..."
, the substrate contaminated with AMC before the substrate is contacted with the purified purge gas;	Page 10 – "The generally accepted protocol for UHP gas line validation requires extensive purging with nitrogen...[h]owever, with all three VUT's XCDA volatized additional hydrocarbons..."
producing a contaminated purge gas by transferring a portion of the outgassed contaminants from the substrate into the purified purge gas removing the contaminated purge gas from the substrate, thereby removing AMC from the substrate.	Page 6 – "As the gas is purged through the VUT, any desorbed contaminants are collected downstream...."

Thus, Van Der Net does not constitute prior art with respect to at least claim 1 of this application. The prior art date of Van Der Net is its filing date of July 21, 2003. The present application claims the benefit of U.S. Provisional Application No. 60/475,145 filed on June 2, 2003. Since Van Der Net does not constitute prior art, the rejection is improper.

It is noted that claim 51 was only rejected as unpatentable over Van Der Net in view of Alvarez. Claim 51 is similar to claim 1, but recites that the purge gas is a humidified purge gas comprising XCDA. Since humidified XCDA is taught in U.S. Provisional Application No. 60/475,145 at pages 14 and 15, Van Der Net does not constitute prior art with respect to claim 51. Thus, claim 51 is patentable.

Nevertheless, assuming *arguendo* that Van Der Net is a valid prior art reference to the present application, a person of ordinary skill in the art would not have been motivated to combine the teachings of Van Der Net and Alvarez. Van Der Net teaches adding moisture to a purge gas to make it effective in reducing contamination, while Alvarez states that it is important to effectively remove water.

In response to the Applicants' arguments supporting lack of motivation to combine the references, the Examiner stated that Van Der Net teaches that the purge gas can have an amount of moisture within the range of 0-100% and that as one possible embodiment, the purge gas of Van Der Net could have water in the ppm range.

Applicants maintain the arguments as set forth in the Reply dated April 30, 2009 and the Reply dated November 30, 2009. The Examiner's argument that "as one possible embodiment" the purge gas could have water in the ppm range ignores the requirement of a reasonable expectation of success, as set forth in MPEP 2143.02. Given the fact that Van Der Net teaches that more than 25% relative humidity provides good results and about 40% provides optimal results, a person of ordinary skill in the art would not have had a reasonable expectation of success in employing a water concentration in the ppm range, as suggested by the Examiner.

Further, if the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. MPEP 2143.01 (V) (Emphasis added). In this case, to carry out the invention of Van Der Net effectively, the reference requires the presence of water in an amount greater than that disclosed by Alvarez (i.e., the order of 1 ppb or lower; col. 7, lines 8-9 of Alvarez). Thus, the Examiner's proposed modification of Van Der Net in view of Alvarez renders the invention of Van Der Net unsatisfactory of its intended purpose.

Reconsideration and withdrawal of the rejection are therefore respectfully requested.

Claims 14-15 and 50 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Van Der Net in view of Alvarez as applied to claims 1, 3-5, 8-9, 11, 38, 40-47, and 49 and further in view of Van Schaik.

The Examiner's rejection is improper for the same reasons with respect to claims 1, 3-5, 8-9, 11, 38, 40-41, 43-47 and 51-54 set forth above. In addition, Applicants assert the same

arguments set forth above with regard to the Examiner's rejection of claims 14-15, 40 and 50 under 35 U.S.C. § 103(a) as over Somekh in view of Wu, Alvarez and Van Schaik. That is, Van Schaik fails to teach or suggest purging the substrate with an inert gas after removing the contaminated purge gas from the substrate.

Reconsideration and withdrawal of this rejection are respectfully requested.

Claims 52 and 53 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Van Schaik in view of Alvarez.

With regard to claim 52, the Examiner stated, "Van Schaik teaches that...the contaminants are removed and not chemically altered." Applicants respectfully direct the Examiner's attention to Van Schaik at col. 7, lines 51-54, which states, "As these OH-radicals are located near to or on the hydrocarbon contaminant residing on said surface, it reacts readily therewith." Thus, the purge gas comprising molecular oxygen and water, as described in Van Schaik, reacts with the contaminants, contrary to the Examiner's assertion.

With regard to claim 53, the Examiner's rejection, which relies upon the indefiniteness rejection discussed above, is improper in view of the Applicants' above arguments in response to the Examiner's rejection under §112, second paragraph.

Further, a claim limitation which is considered indefinite cannot be disregarded. MPEP 2143.03 (I). If a claim is subject to more than one interpretation, at least one of which would render the claim unpatentable over the prior art, the examiner should reject the claim as indefinite under 35 U.S.C. § 112, second paragraph and should reject the claim over the prior art based on the interpretation of the claim that renders the prior art applicable. Id., (Emphasis in original). Here, the Examiner has failed to provide support for the rejection under § 103(a) and the rejection is therefore improper.

Reconsideration and withdrawal of the rejection are therefore respectfully requested.

Double Patenting Rejections

The Examiner rejected claims 1, 3-5, 11, 14-15, 38, 40-41, 43-45, 50 and 52-54 on the ground of nonstatutory obviousness-type double patenting over claims 1-4, 7, 9-14, and 20-23 of

U.S. Patent No. 7,189,291. Applicants will address this issue upon indication of allowable subject matter.

The Examiner rejected claims 1, 3, 8, 11, 14-15, 38, 41, 43, 46 and 50-54 on the ground of nonstatutory obviousness-type double patenting over claims 1, 6, 11-21 and 23-24 of U.S. Patent No. 7,377,982. Applicants will address this issue upon indication of allowable subject matter.

Supplemental Information Disclosure Statement

An Supplemental Information Disclosure Statement (SIDS) is being filed concurrently herewith. Entry of the SIDS is respectfully requested.

Request for Interview

Applicants respectfully request an interview with the Examiner before the issuance of another Office Action or other communication.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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Air Composition

Dry air is a mechanical mixture of nitrogen, oxygen, carbon dioxide and more

Air is a mixture of gases - ***78% nitrogen*** and ***21% oxygen*** - with traces of water vapor, carbon dioxide, argon and various other components. Air is usually modeled as a uniform (no variation or fluctuation) gas with properties averaged from the individual components.

Gas	Ratio compared to Dry Air (%)		Molecular Mass - M - (kg/kmol)	Chemical Symbol	Boiling Point	
	By volume	By weight			(K)	(°C)
Oxygen	20.95	23.20	32.00	O_2	90.2	-182.95
Nitrogen	78.09	75.47	28.02	N_2	77.4	-195.79
Carbon Dioxide	0.03	0.046	44.01	CO_2	194.7	-78.5
Hydrogen	0.00005	~ 0	2.02	H_2	20.3	-252.87
Argon	0.933	1.28	39.94	Ar	84.2	-186
Neon	0.0018	0.0012	20.18	Ne	27.2	-246
Helium	0.0005	0.00007	4.00	He	4.2	-269
Krypton	0.0001	0.0003	83.8	Kr	119.8	-153.4
Xenon	$9\ 10^{-6}$	0.00004	131.29	Xe	165.1	-108.1

- The water or vapor content in air varies. The maximum moisture carrying capacity of air depends primarily on temperature
- The composition of air is unchanged until elevation of approximately *10.000 m*
- The average air temperature diminishes at the rate of *0.6°C* for each *100 m* vertical height
- "One Standard Atmosphere" is defined as the pressure equivalent to that exerted by a *760 mm* column of mercury at *0°C* sea level and at standard gravity (*32.174 ft/sec²*)

Other components in air

- Sulfur dioxide - SO_2 - *1.0 parts/million (ppm)*
- Methane - CH_4 - *2.0 parts/million (ppm)*
- Nitrous oxide - N_2O - *0.5 parts/million (ppm)*
- Ozone - O_3 - *0 to 0.07 parts/million (ppm)*
- Nitrogen dioxide - NO_2 - *0.02 parts/million (ppm)*
- Iodine - I_2 - *0.01 parts/million (ppm)*
- Carbon monoxide - CO - *0 to trace (ppm)*
- Ammonia - NH_3 - *0 to trace (ppm)*

Common Pressure Units frequently used as alternative to "*one Atmosphere*"

- *76 Centimeters (760 mm) of Mercury*
- *29.921 Inches of Mercury*
- *10.332 Meters of Water*
- *406.78 Inches of Water*
- *33.899 Feet of Water*
- *14.696 Pound-Force per Square Inch*
- *2116.2 Pounds-Force per Square Foot*
- *1.033 Kilograms-Force per Square Centimeter*
- *101.33 Kilopascal*

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- Material Properties Material properties - density, heat capacity, viscosity and more - for gases, fluids and solids

Related Documents

- Air Properties Temperature, density, specific heat, thermal conductivity, expansion coefficient, kinematic viscosity and Prandtl's number for temperatures ranging *-150 - 400 °C*
- Specific Heat Ratio of Air Specific Heat Ratio of air at temperatures from *-40 - 1000 °C* (*-40 - 1500 °F*) at standard atmospheric pressure - Imperial and SI Units

EXHIBIT
tabbies
A

Convert !

Pressure

1

- Pa (N/m²)
- bar
- mm H_2O
- kg/cm²
- psi
- inches H_2O

Convert !

Flow

1

- m^3/s
- m^3/h
- US gpm
- cfm

Convert !

Unit Converter

Scientific

Calculator

Free Industry Resources

How Scientific Business Intelligence Can Drive Top Line Innovation Growth

When Safety Matters: Key Factors to Consider When Selecting Flame Resistant Protective Clothing

Justifying IT Security, Managing Risk & Keeping Your Network Secure

Industry standards testing: ASM, ASME, IEEE, ISO, API.

TECHSTREET

- Humid Air and the Ideal Gas Law The Ideal Gas Law relating pressure, temperature, and volume of an ideal or perfect gas used for air with water vapor - or moist air
- Molecular Mass of Air Dry air is a mixture of gases where the molecular weight can be calculated by adding the weight of each component
- Density of Dry Air, Water Vapor and Moist Humid Air Calculate the density of dry air, water vapor or the mixture of air and water vapor - moist or humid air
- Dry Air Properties Dry air properties at temperatures ranging 175 - 1900 K - specific heat capacity, ratio of specific heats, dynamic viscosity, thermal conductivity, Prandtl number, density and kinematic viscosity
- Nitrogen - Specific Heat Capacity Specific heat capacity of Nitrogen Gas - N_2 - at temperatures ranging 175 - 6000 K
- Oxygen - Specific Heat Capacity Specific heat capacity of Oxygen Gas - O_2 - at temperatures ranging 175 - 6000 K
- Ideal Gas Properties Oxygen Enthalpy, Internal Energy and Entropy of Oxygen

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bering (ˈæmbərɪŋ), *vbl. sb.* [f. AMBER *v.*]
53 CHAMBERS *Cycl. Supp.*, *Ambering* is used by some ers to denote the giving a scent or perfume of amber to hing

ıberjack. Also amber jack. [AMBER *sb.*¹] A cies of amber-fish, esp. *Seriola dumerili*.
93 *Funk's Stand. Dict.*, *Amber-jack*, an amber fish iola lalandi 1897 [see prec.] 1960 *Catal. Names Fishes* ıı (Gen. Fish. Council Medit.) 161 Seriola dumerili ıer jack.

beroid, var. AMBROID.

ıber-seed. [f. AMBER *sb.*¹ in reference to ır agreeable odour and use.] An old name for seeds of *Abelmoschus moschatus*, also called ısk-seed, and Ambrette, used to perfume r-powder, pomatum, etc.
'27-51 CHAMBERS *Cycl.*, *Amber-seed* or *Musk-seed* s a grateful scent to the breath.

ıber-ˌtree. [f. AMBER *sb.*¹ in reference to the ŗrant odour of its leaves.] A common name of genus *Anthospermum*, consisting of rgreen shrubs with leaves fragrant when ısed.
ı47 CRAIG, *Anthospermum*, the Amber-tree, a heath-ıng shrub from the Cape of Good Hope.

ıbery (ˈæmbərı), *a.* [f. AMBER *sb.*¹ + -Y¹.] Of nature or colour of amber.
ı62 THORNBURY *Turner* I. 80 A landscape-painter ıred for a rich ambery tone he knew how to give.

ıbery, obs. form of AMBRY.

ıbes ace, **ambes-as**, obs. ff. AMBS-ACE.

ıbi- (æmbı), repr. L. *ambi-* both, on both es (*ambo* both), in various (chiefly scientific) ms (see words in *ambi-*). **ambiciliate** (-ˈsılıət), *Ichth.*, having the scales on both sides of the ly minutely toothed along the edges. **bicolorate** (-ˈkolərət, -ˈkʌl-) *a. Ichth.*, applied lat-fishes abnormally coloured on both sides tead of having the under side white; so **bicoloˈration**.
ı94 *Proc. Zool. Soc.* 439 Ambicolorate fish appear to be ıys what one may call ambiciliate also. *Ibid.* 435 Why lopean examples should be ambicolorate. *Ibid.* (*heading*) On an Adult Specimen of the Common Sole with ımetrical Eyes, with a Discussion of its bearing on bicoloration.

ımbiate, *v.* *Obs. rare*⁻¹. [irreg. f. L. *ambi-re* e AMBITION) + -ATE³.] To desire earnestly, be bitious of, ambition.
ı52 SPARKE *Prim. Devotion* (1663) 162 You few that dom above treasure prize, And ambiate the title of the ?

ıbidexter (ˌæmbıˈdɛkstə(r)), *a.* and *sb.* Also ʒ ambodexter. [a. med.L. *ambidexter* (used in ıses 2, 3), f. *amb(i)-* both, on both sides + *dexter* right-handed. In 17th c. generally spelt *bodexter*, after L. *ambo* both.] A. *adj.*
1. *lit.* Right-handed on both sides, able to use left hand as well as the right.
646 SIR T. BROWNE *Pseud. Ep.* 191 So may Aristotle say, ı only man is Ambidexter. 1751 SMOLLETT *Per. Pic.* 79) IV. xcix. 202 Being ambi-dexter, he raised a clatter ın the turnkey's blind side. 1880 BLACKMORE *M. Anerley* xxv. 283 With his left hand, for he was ambidexter, he ght up a handspike.
2. Double-dealing, practising on both sides.
613 SIR H. FINCH *Law* (1636) 186 To call..an Attornie bodexter, or to say that he dealeth corruptly. 1624 F. S. *Shaks. Cent. Praise* 154 These ambi-dexter Gibionites. 5 H[ICKERINGILL] *Priest-cr.* I. (1721) 44 Nor Ambodexter ıyers take a Fee On both sides. 1856 DOVE *Logic Chr. Fr.* ı. ii. §2. 94 Tortuous and ambidexter sophistries.
3. Of or belonging to both hands or sides; o-sided.
806 W. TAYLOR *Ann. Rev.* IV. 228 Posted by double ry with the ambidexter formality of an Italian ledger. ı9 SIR J. STEPHEN *Ess. Eccl. Biog.* (1850) II. 37 An bidexter controversialist, the English Church warred at e with the errors of Rome and of Geneva.
B. *sb.* [The adj. used *absol.*]
1. One who uses the left hand as well as the ht; hence *fig.* a man of unusual dexterity.
598 FLORIO *Ded.* 1 If we be not ambidexters, vsing both ıdes alike. 1615 CROOKE *Body of Man* 732 A woman, saith ıocrates, cannot be an ambidexter. 1753 CHAMBERS *Cycl. Supp.* s.v., Surgeons and oculists are of necessity obliged to Ambidexters.
2. *Law.* One who takes bribes from both sides. he earliest sense in Eng.)
532 *Use of Dice Play* (1850) 17 Any affinity with our men aw.. Never with those that be honest. Marry! with such be ambidexters, and use to play in both the hands. 1652 GAULE *Theoph.* xiii. xviii. 238 From costly bills of greedy ıp'ricks free, From plea of Ambo-dexters fee. 1691 ..825 In this Battell I espy'd Some Ambodexters, fight on either side. 1703 DE FOE *Ref. Manners* 93 Those Ambo-Dexters in Religion, who Can any thing dispute, yet any thing can do. 1864 SIR F. PALGRAVE *Norm. & Eng.* III. 278 An Ambidexter, owing fealty to both Counts and not faithful to either.

ambidexterity (ˌæmbıdɛkˈstɛrıtı). [f. prec. + -ITY, after *dexterity*.]
1. The power of using both hands alike.
*a*1652 BROME *Court Beggar* ı. i. 191 Some Tellers Clearke to teach you Ambo-dexterity in telling money. 1753 CHAMBERS *Cycl. Supp.* s.v., Plato enjoins Ambidexterity to be observed and encouraged in his republic. 1881 *Times* 2 Feb. 10/5 The single-stick play.. was remarkable for its ambidexterity.
2. *fig.* Superior dexterity or cleverness; shiftiness or general readiness, manysidedness.
1760 STERNE *Trist. Shandy* II. xxxvii. 103 Speculative subtilty or ambidexterity of argumentation. 1804 W. TAYLOR *Ann. Rev.* II. 278 The idiomatic ambidexterity of a patriot of both countries. 1858 DE QUINCEY *Autobiog. Sk. Wks.* II. ii. 76 Presence of mind, and a general ambidexterity of powers for facing all accidents.
3. Double-dealing.
1755 in JOHNSON. 1841 D'ISRAELI *Amen. Lit.* (1859) I. 362 That intricate net of general misery, spun out of his own crafty ambidexterity.

ambidextral (ˌæmbıˈdɛkstrəl), *a. rare.* [f. L. *ambidexter* + -AL¹.] Belonging to both sides.
1871 EARLE *Philol. Eng. Tong.* 684 What may be called the ambidextral adjective.. Thus Chaucer—'I say the woful day fatal is come.'

ambidextrous, **-erous** (ˌæmbıˈdɛkstrəs), *a.* [f. med.L. *ambidexter* + -OUS.] = AMBIDEXTER.
1. Able to use both hands alike.
1646 SIR T. BROWNE *Pseud. Ep.* 188 Not considering ambi-dextrous and left handed men. 1751 CHAMBERS *Cycl.* s.v., Women, according to the observation of Hippocrates, are never ambidextrous. 1878 BRYANT *Pract. Surg.* I. 340 Every ophthalmic surgeon should.. become ambidextrous.
2. *fig.* More than usually dextrous, or clever.
1682 SIR T. BROWNE *Chr. Mor.* (1756) 117 Many, who are sinistrous unto good actions, are ambi-dexterous unto bad. 1844 *Blackw. Mag.* LVI. 54 O many-sided, ambidextrous Goethe.
3. Acting in two opposite directions; and in a bad sense, Double-dealing; humouring both parties.
1654 GATAKER *Disc. Apol.* 77 An ambidextrous Trick.. of divers persons in the same familie adhering some to one partie and some to another. *a*1768 STERNE *Pol. Romance* (1774) 31f. A little, dirty, pimping, pettifogging, ambidextrous fellow. *a*1847 CHALMERS *Posth. Wks.* I. 22 Rebuking Peter for his ambidextrous policy between Jews and Gentiles. 1858 J. MARTINEAU *Stud. Chr.* 279 It would be hypercritical to complain of the antithesis of understanding and feeling, sense and soul. But to an exact thinker.. an ambidextrous intellect is no intellect at all.

ˌambiˈdextrously, **-erously** *adv.* [f. AMBIDEXTROUS, -EROUS *a.* + -LY².] In an ambidextrous manner; with both hands; with more than usual dexterity; cunningly.
1791–1823 D'ISRAELI *Cur. Lit.* 459 To prove himself not to have been the author, [he] ambidexterously published another. 1837 *Blackw. Mag.* XLI. 439 Ambidexterously plying her knitting-needles.

ˌambiˈdextrousness. [f. as AMBIDEXTROUSLY *adv.* + -NESS.] The quality of being ambidextrous; ambidexterity.
1721 in BAILEY. 1881 *Sat. Rev.* No. 1323. 301 The remarkable ambidextrousness which he shows.

†**ˌambiˈdextry**. *Obs. rare*⁻¹. In 7 ambo-. [ad. med.L. *ambidextria*, f. *ambidexter*.] Double-dealing. Cf. AMBIDEXTER B 2.
1611 *Brief* in *3rd Rep. R. Comm. Hist. MSS.* (1872) 58/1 For ambodextry and disturbing the King's service, and threatening the jurors.

ambience (ˈæmbıəns). Also **ambiance** (ɑ̃biɑ̃s). [f. AMBIENT *a.*: see -ENCE; cf. F. *ambiance*.] Environment, surroundings; atmosphere.
The Fr. form *ambiance* is used in *Art* for the arrangement of accessories to support the main effect of a piece.
1889 *Harper's Mag.* Sept. 500/2 The form which we discern in the dreamy ambience is of supreme elegance. 1902 W. WATSON *Ode on Coronation of King Edward VII* 5 Slowly in the ambience of this crown Have many crowns been gathered. 1923 R. H. MYERS *Mod. Music* iv. 47 No other composer has ever reproduced in music with such complete success the very perfume and ambiance of a literary text. 1944 *Burlington Mag.* June 156/1 But the present picture was never meant to be microscopically dissected thus, for it is.. an impression, a single figure in its *ambiance* which is vaguely suggested as reflections in a mirror. 1952 *Ballet Ann.* VI. 25 The costumes and sets.. have such a suggestion of space that they give the Sadler's Wells stage the *ambiance* of Covent Garden. 1957 *London Mag.* Jan. 52 For some writers the urban ambience may provide just the kind of stimulus they need. 1961 *Listener* 5 Oct. 527/2 The Zoo provides a colourful ambience for this ...

so called from the way in which it winds in passing from the hip to the foot.
1873 A. H. GARROD in *Proc. Zool. Soc.* 630 The ambiens and the accessory femoro-caudal are absent. 1884 COUES *N. Amer. Birds* (ed. 2) 191 The ambiens arises from the pelvis about the acetabulum, and passes along the inner side of the thigh.

ambient (ˈæmbıənt), *a.* and *sb.* [ad. L. *ambientem* pr. pple. of *ambire* to go about, f. *amb-* on both sides, round, about + *ī-re* to go. Cf. It. *ambiente* bef. 1600.] A. *adj.*
†1. Turning round, revolving. *Obs. rare.*
1614 CHAPMAN *Odyss.* I. 28 The point of time wrought out by ambient years. 1620 —— *Homer's Hymns* Ep. Ded., Of all arts ambient in the orbe of Man.
2. Moving round, circling about (something). *rare.*
1655–60 STANLEY *Hist. Philos.* (1701) 64/1 The ambient æther.. by the swiftness of its Motion, snatcheth up Stones from the Earth. 1692 BENTLEY *Boyle Lect.* 234 That the planets should naturally attain these circular revolutions by impulse of ambient bodies. 1834 DISRAELI *Rev. Epick* I. xxx. 15 Ye ambient Winds, That course about the quarters of the globe.
3. Lying round, surrounding, encircling, encompassing, environing.
1596 BELL *Surv. Popery* I. I. xvi. 69 As well for the ambient restraint. 1658 SIR T. BROWNE *Gard. Cyrus* i. 103 The tree of knowledge was placed in the middle of the Garden.. what ever was the ambient figure. *c*1750 SHENSTONE *Elegy* ix. 38 Exalted to yon ambient sky. 1784 BOSWELL *Johnson* (1816) IV. 428 A captive in thy ambient arms. 1850 BLACKIE *Æschylus* II. 37 With echoing groans the ambient waste bewails Thy fate. 1928 E. A. WILCOX *Electric Heating* v. 128 Tank temperatures are constantly maintained at 100° F. above surrounding (or *ambient*) temperatures. 1958 *Engineering* 28 Mar. 393/3 The air pressure within the dome is maintained at the not uncomfortable figure of 2 lb per sq in above the ambient pressure.
4. *esp.* Surrounding as a fluid, circumfused.
1605 BACON *Adv. Learn.* (1640) 201 Consumption is caused by.. Depredation of innate Spirit and Depredation of ambient Aire. 1667 MILTON *P.L.* vi. 481 Opening to the ambient light. 1711 POPE *Temp. Fame* 26 Whose tow'ring summit ambient clouds conceal'd. 1806 VINCE *Hydrost.* x. 110 If the plate be cold and the ambient fluid be warm. 1866 KINGSLEY *Herew.* v. 104 It diffused a delicate odour through the ambient air.
5. Rounded like a solid body. *rare.*
1801 FUSELI *Lect. Art* i. (1848) 360 He who decided his outline with such intelligence that it appeared ambient, and pronounced the parts that escaped the eye.
†6. Ambitious, aspiring. (A Latinism.) *Obs. rare.*
1647 N. BACON *Hist. Disc.* III. 12 The Clergy.. soon began to be ambient and conceipt a new Idea of deportment.
¶ As an epithet of the air, often ignorantly put for 'limpid,' or otherwise misused.
B. *sb.* [The adj. used *absol.*]
†1. A canvasser, suitor, or aspirant. *Obs. rare.*
1649 BP. HALL *Confirmation* (1651) 16 What Fair-like confluences have we there seen of zealous ambients?
2. An encompassing circle or sphere.
1624 WOTTON *Elem. Archit.* (1672) 7 The aire.. being a perpetual ambient and ingredient. 1657 TOMLINSON *Renou's Disp.* 547 They are broad, asperated about their ambient. 1864 MACVICAR in *Reader* IV. 670/1 Atoms or molecules have extensive atmospheres or ambients of some kind.
3. *Astrol.* The ambient air or sky.
1686 GOAD *Celest. Bodies* III. iii. 472 ♄ and ♃, by the Repetition of the Aspect, may sometimes disturb the Ambient above a year. 1868 GEO. ELIOT *Sp. Gypsy* 193 For the ambient.. Though a cause regnant, is not absolute.

ambiente (æmbıˈɛnteı). [It. and Sp., f. L. *ambient-em*: see AMBIENT *a.* and *sb.*] = AMBIENCE.
1926 D. H. LAWRENCE *Plumed Serp.* xii. 197 He was utterly still.. soft and unroused, within his own *ambiente*. 1927 —— *Lett.* (1962) II. 988 So with the mind. One's *ambiente* matters awfully. 1965 *House & Garden* Dec. 37/1 Within the entertaining ambiente of this decoratively practical kitchen dining-room. 1966 M. STEEN *Looking Glass* ix. 75, I couldn't afford it, but I liked the *ambiente*.

†**ambiˈfarious**, *a.* *Obs.*⁻⁰ [f. L. *ambifāri-us* two-sided, of double meaning + -OUS.] 'Double, or that may be taken both ways.' Blount *Glossogr.* 1656; whence in Bailey 1721.

†**ˈambiform**, *a.* *Obs.*⁻⁰ [ad. L. **ambiform-is* (in adv. *ambiformiter*), f. *amb(i)-* both + *-formis* -shaped.] 'Having a double form.' Bailey 1721.

†**ˈambigate**, *v.* *Obs. rare*⁻¹. [irreg. f. L. *ambigĕre* to go round (taken as = *ambire*: see AMBITION) + -ATE³.] = AMBIATE.
1633 T. ADAMS *Exp. 2 Pet.* i. 6 There are some things, wherein it is no godliness to ambigate a likeness to God.

ambigenal (æmˈbıdʒınəl), *a.* [f. (by Newton) L. ...

ambig... *ambigen*... *spec.* ap... calyx, ... petaloic... 1850 H... *Lea*...
†'**ambi**... prop. ac... which ... togethe... on. 1688 ... their Sati... *Life* (184... *c*160 17... of mixed... served to...
†**am'bi**... AMBIGU... 1683 C... some amb... the news...
†**ambi**... ? Fr. *ai*... *a*1733 ... of *runnir*...
ambig... etc. [... med.L... AMBIGU... †1. ... hesitati... course. *c*1400 ... *Pol. Poer*... ambiguy... amb.guy... *Verg. E*... ambiguit... I make y... ambiguit... †2. *c*... 1598 I... ambigu t... *Bps.* iv... which w... 3. a... underst... dubiou... *c*1430 ... ambiguit... *Compl. S*... ambiguit... Schoolm... and the ... ambiguit... The kin... expressio... II. 665 ... ambiguit... Confusio... language... b. *spe*... 1930 ... ambiguit... pronoun... use the w... to any sul... which ac... ted 1. 19... nuance ... reactions ... Nowotn... now has ... ways in ... multiple ... form of ... differenc... not easi... form. *H*... the many... 4. *con*... than or... 1591 ... the ambi... plain for... hand ai... 1699 Br... be here... *Elem. L*... intreque...
ambig... doubtf... *ĕre*, f. ... -OUS.] ... in Lati... I. Ob... 1. Do...

outfront leadership. **1976** L. ALTHER *Kinflicks* ii. 22 'Have you seen the new fishburger franchise?' Mrs Yancy asked, pointing out the window at a red and silver building with a sign out front featuring in neon a one-legged pirate tangoing with a laughing swordfish. **1977** *New Yorker* 10 Oct. 156/3 Powell himself was said to be deeply bothered by that, and to have realized that he had been too 'out front' on the issue.

out'frown, *v.* [OUT- 23 a, 18 c.] *trans.* To outdo in frowning; to frown down, overbear by frowning.

1605 SHAKS. *Lear* v. iii. 6 My selfe could else out-frowne false Fortunes frowne. **1807** W. H. IRELAND *Mod. Ship Fools* 61 *note*, It is only the base-born churl, like Thomas à Becket, that would out-frown the brow of majesty.

†'**out-,funeral**. *Obs. rare*⁻¹. [OUT- 1.] A funeral outside a city, extra-mural interment.

1637 BP. HALL *Serm. at Exeter* 24 Aug. (R.), Much might be said to this purpose [out of matter of wholesomnesse] for the convenience of out-funerals.

out-ga, outgait, obs. ff. OUTGO, OUTGATE.

out'gallop, *v.* [OUT- 18.] *trans.* To outdo in galloping; to gallop faster than.

1603 DEKKER *Wonderfull Yeare* D iij b, They that rode on the lustiest geldings, could not out gallop the Plague. **1852** THACKERAY *Esmond* III. i, A hundred huntsmen.. each out-bawling and out-galloping the other.

'**outgang**. Now *Sc.* or *north. dial.* [OUT- 7; OE. *ūtgang*; cf. Du. *uitgang*, Ger. *ausgang*.]

1. A going out, departure, exit; the giving up of the occupancy or tenure of property.

*c*825 *Vesp. Psalter* xviii. [xix.] 7 From ðæm hean heofene utgong his. *a*1000 *Life St. Guthlac* ii. (1848) 14 þurh sarlicne utgang þæs manfullan lifes. *a* 1300 *E.E. Psalter* xxx 23 [xxxi. 22] In out-gang of thoghte mine. *c* 1320 *Cast. Love* 878 þorw þe faste þat he con in teo, And at þe out-ȝong he lette faste beo. **1887** *Jamieson's Sc. Dict.* Suppl., *Out-ganging*, *Outgang*, ..outgoing, removal; the act of giving up possession of burghal property.

2. The way or passage out; an outlet, an exit; a road by which cattle went out to the pasture.

*c*950 *Lindisf. Gosp.* Matt. xxii. 9 Geongas forðon to ut-geonge ðære wegara [*c* **975** *Rushw.* to utgengum weoȝas]. *a* 1300 *E.E. Psalter* cxliii. [cxliv.] 16 þair schepe brodefulle mightsomande In þar outgange. *c* **1450** *Customs of Malton* in *Surtees Misc.* (1888) 58 Fre entre and goyng owte to yᵉ more by a large way, the qwhyche is called yᵉ owtegang. **1513** DOUGLAS *Æneis* (Cr. Gl.), Ane narrow path baith outgang and entre. **1664-5** *Act 16-17 Chas. II*, c. 11 §2 The River of Welland from the Outgang at the East end of East Deeping. **1828** *Craven Gloss.* (ed. 2), *Out-gang*, a road from a place. **1896** T. BLASHILL *Sutton-in-Holderness* 26 An ordinary outgang was a place where the cattle of a village assembled when they were to be driven out together to graze in common.

out-garment, -garth, etc.: see OUT-.

outgas (aʊt'gæs), *v.* [OUT- 26.] 1. *trans.* **a.** To drive off sorbed gas or vapour from (a solid), esp. by heating in a vacuum.

1921 [implied in OUTGASSED *ppl. a.*]. **1925** *Physical Rev.* XXVI. 658 When the surface layer of gas is removed from a fresh specimen the increase in the photo-electric current is greater than the decrease from the maximum value as the specimen is outgassed. **1953** *Electronic Engin.* XXV. 19 The cathodes were out-gassed by eddy-current heating. **1965** C. M. VAN ATTA *Vacuum Sci. & Engin.* iii. 101 After the gauge tube and elements have been thoroughly outgassed, an opposite effect becomes noticeable.

b. To release (sorbed or dissolved gas or vapour).

1971 I. G. GASS et al. *Understanding Earth* ix. 137/2 Only gradually, as volcanoes continued to outgas volatile products still trapped in the mantle, will a secondary atmosphere and ocean have replaced the primary envelope. **1974** *Nature* 31 May 438/1 If NH_3 is outgassed from the Martian crust it would be photolysed.

2. *intr.* To give off sorbed gas or vapour.

1962 [implied in OUTGASSING *vbl. sb.*]. **1965** C. M. VAN ATTA *Vacuum Sci. & Engin.* ix. 365 Untreated metal samples outgas at the rate of about 10^{-7} torr liter/sec cm² after 1 hr of vacuum pumping at room temperature. **1975** *Sci. Amer.* Feb. 110/3 Any polymer surface will outgas (a 'virtual leak' into your clean volume) two orders of magnitude more than steel.

So out'gassed *ppl. a.*, out'gassing *vbl. sb.*

1921 *Proc. Nat. Acad. Sci.* VII. 115 The coarsely granular sample of the thoroughly outgassed material is weighed and placed in a steel pressure bomb which is then evacuated until all adsorbed gases are removed. **1925** *Physical Rev.* XXVI. 657 His thermionic measurements show that the value of *A* in the Richardson equation.. decreases from 4.76 × 10^{21} for the slightly outgassed position to 1.7 × 10^{26} for continued outgassing. **1952** *Trans. Faraday Soc.* XLVIII. 739 The vessel F was 'protected' by a series of traps in liquid air, some of which..contained carefully outgassed granulated charcoal. **1962** F. I. ORDWAY et al. *Basic Astronautics* iii. 49 Whatever outgassing that may occur from the surface would expectedly give rise to a more substantial, albeit tenuous, atmosphere. **1971** I. G. GASS et al. *Understanding Earth* ii. 43/2 This so-called 'excess' argon is probably produced by heating and outgassing of ancient, potassium-bearing rocks. **1973** *Nature* 3 Aug. 272/2 The relative abundances of these gases will depend critically on the subsequent history of the outgassed methane. **1973** B. J. WILLIAMS *Evolution & Human Origins* vii. 97/2 If these dates are correct then the evolution of life must have begun, as we would expect, almost immediately after the earth's crust melted and the outgassing of the early atmospheric gases ceased.

'**outgate**, *sb.* (*adv.*) Also *Sc.* -gait. Now *Sc.* and *north. dial.* [OUT- 7.]

1. The action of going out; outgoing, passage out, exit, egress; debouching.

a 1300 *E.E. Psalter* cxiii. [cxiv.] 1 In oute-gate of Israele Oute of Egipt. *c* **1440** *Promp. Parv.* 375/2 Owte gate, *exitus*. **1455** *Rolls of Parlt.* V. 311/2 Free ingate and outgate to the premisses. **1496**, **1598** [see INGATE 1]. **1615** CROOKE *Body of Man* 766 The outgate of the breath is hindered. **1822** GALT *Sir A. Wylie* I. xxviii. 259 (Jam.) She..maybe a wee that dressy and fond o' outgait. **1865** CARLYLE *Fredk. Gt.* xviii. ii. (1872) VII. 106 Moldau Valley.. making, on its outgate at the northern end of Prag.. one big loop.

2. A passage or way out, an outlet; a means of egress; *fig.* a way of escape or deliverance.

1456 SIR G. HAYE *Law Arms* (S.T.S.) 179 Than suld never promess na obligacioun bynd a fals man, na he wald get ane outgate. **1513** DOUGLAS *Æneis* ix. vii. 28 Sone ombeset haue thai The outgatis al. **1596** SPENSER *State Irel.* Wks. (Globe) 665/1 Those paces are sue fitt for trade and trafficke, having most convenient out-gates by diverse rivers to the sea. **1616** SURFL. & MARKH. *Country Farme* 688 If he meet with a hedge, he holdeth along by the side of it, to see if he can find any out-gate. **1659** A. HAY *Diary* (S.H.S. 1900) 194 The Lord provyd ane outgate for his people. **1865** CARLYLE *Fredk. Gt.* xx. ix. (1872) IX. 165 The dragoons were a hundred, and..every outgate was beset.

b. Issue, outcome. *Sc.*

1568 MARY Q. SCOTS in H. Campbell *Love-lett.* App. (1824) 29 To the effect the samin sould be the mair prompthe endit with some happy outgait to my honour and contentment. **1663** BLAIR *Autobiog.* ii. (1848) 32 Wondering what would be the outgate. **1786** A. GIB *Sacr. Contempl.* 318 Others are brought more quickly to an happy outgate.

†3. Usually in *pl.* Goods 'going' or carried out of a town or port, exports; also, export dues.

1621-1886 [see INGATE *sb.*¹ 4].

B. *adv.* Outwards; outside, without.

1590, **1611** [see INGATE *sb.*¹ B]. **1898** CROCKETT *Standard Bearer* xxxiv. 301 May they burn back and front, ingate and outgate.

'**out-,gate**. Outer gate; see OUT- 3.

1648 *Depos. Cast. York* (Surtees) 12 Robert Kay, together with 16 or 18 men.. with musketts and swords drawne,.. broke open the outgate and fower other doores within the said house. **1664** J. WEBB *Stone-Heng* (1725) 94 The Anditus had both an Out-gate, and an inner Gate.

out-gather, -gauge, etc.: see OUT-.

outgear ('aʊtgɪə(r)). *Sc. rare.* [OUT- 1.] Possessions or substance used in out-door occupation.

1834 H. MILLER *Scenes & Leg.* xxiv. [see INGEAR].

out'general, *v.* [OUT- 22.] **a.** *trans.* To outdo or defeat in generalship; to get the better of as by superior military skill; to outmanœuvre.

1767 S. PATERSON *Another Trav.* I. 202 How we were out-generalled indeed! **1776** J. ADAMS in *Fam. Lett.* (1876) 231 In general, our Generals were outgeneraled on Long Island. **1897** *Century Mag.* Feb. 495 In these movements Lee was entirely outgeneraled.

b. *transf.* and *fig.*

1859 J. S. MILL in *Fraser's Mag.* LX. 767/1 A nation which thinks of nothing but of outwitting and outgeneralling its neighbours. **1910** J. DRISCOLL *Ringcraft* 14 He was the better boxer and the stronger man, but was outgeneralled during two-thirds of the bout. **1940** W. FAULKNER *Hamlet* III. ii. 184 At last he outgeneralled himself with his own strategy: ..even his father admitted that there was nothing else about the farm for him to learn. **1973** WODEHOUSE *Bachelors Anonymous* x. 128 However confident he may be that he has outgeneralled a woman, a man likes to have reassurance on the point from a knowledgeable third party. **1976** *Billings* (Montana) *Gaz.* 26 June 1-B/6 Tanner has played better tennis.. little Kirmayr out-generalled him time and again.. but always in reserve was his 140 m.p.h. cannonball service.

out-get to **out-girth**: see OUT-.

out'give, *v.* [OUT- 18, 14.] **a.** *trans.* To outdo in giving, give more than. **b.** *intr.* To give out, come to an end. (*poetic.*)

1693 C. DRYDEN in *D.'s Juvenal* vii. (1697) 173 The bounteous Play'r out-gave the pinching Lord. **1893** BRIDGES *Shorter P.* v. xi. 31 And two days ere the year outgave We laid him low.

'**out,giving**, *vbl. sb.* [OUT- 9.] The action or fact of giving out; that which is given out: **a.** *pl.* payments, disbursements; **b.** utterance.

1663 BLAIR *Autobiog.* ii. (1848) 25 All the disbursements and outgivings to traders. **1865** *Morn. Star* 20 Jan., The outgivings of some irresponsible editor. **1881** *Times* 15 Apr. 6/1 This was the burthen of all his outgivings before and after inauguration. **1897** *Educat. Rev.* XIII. 70 To regard that as the last outgiving of political philosophy.

outgiving ('aʊtgɪvɪŋ), *ppl. a.* [OUT- 10.] That gives out; open-hearted, generous. Hence **out'givingness**.

1942 J. LEES-MILNE *Ancestral Voices* (1975) 31 K. as outgiving as ever. **1961** *Spectator* 26 May 763/2 [Brendan] Behan is still..a talker and singer for talking and singing's own sake, spontaneous and out-giving. **1963** *London Mag.* Sept. 11 Her face was round and pleasantly fleshed, her eyes cool and outgiving when she was not anguished or perturbed. **1968** *Listener* 10 Oct. 458/2 She had lost a great deal, I think, of her out-givingness in that way and the novels perhaps reflect this. **1972** *Times* 3 July 16/7 There can rarely have been such an outgiving man who was less of an extrovert.

†**out-'glad**, *v.* *Obs.* [OUT- 20.] *trans.* To surpass in gladness; to delight more.

a **1657** R. LOVEDAY *Lett.* (1663) 26 You have not a friend hath out-gladded me for your well-being, nor out-wish'd me for the continuance. *Ibid.* 192 Might I hope the happiness to meet you at London, nothing would be able to out-glad me.

¶ An intrans. *outglad* has been erroneously inferred from Wyclif's *full out glad*: cf. OUT- 15 b.

out'glare, *v.* [OUT- 18.] *trans.* To surpass or outdo in glare or dazzling effect; to be more glaring or flagrant than.

1648 HERRICK *Hesper.*, *Welcome to Sack* 11 Whose radiant flame Out-glares the heav'ns Osiris. **1822** SCOTT *Pirate* xxxi, Were all my former sins doubled.. such a villany would have outglared and outweighed them all. **1837** *Blackw. Mag.* XLII. 329 [She] lavished her money till she out-glared the poorer ranks of the peerage.

out'glitter, *v.* [OUT- 18.] *trans.* To surpass in glitter or splendour.

1648 J. BEAUMONT *Psyche* II. ccxviii, The gracious splendor of this Queen Sweetly outglitters their best tire of Rays. **1662** COKAINE *Tragedy of Ovid* IV. i, I must Out-glitter all the Femals of the Province, Or I shall want my will. **1884** SUS. H. WARD in *Independent Alm.* (N.Y.) 14 You cannot wish the background to outglitter the picture.

out-gloom, -glory, etc.: see OUT-.

out'glow, *v.* [OUT- 18.] *trans.* To excel in glowing; to overcome by superior glow.

1877 E. R. CONDER *Bas. Faith* ix. 390 Capable of dominating every other passion, of outglowing the fire of youth. **1898** T. HARDY *Wessex Poems* 175 My light in thee would out-glow all in others.

out-gnaw, etc.: see OUT-.

'**outgo**, *sb.* [OUT- 7.]

1. The fact of going out or that which goes out; *spec.* outlay, expenditure; opposed to *income*.

c **1640** J. SMYTH *Lives Berkeleys* (1883) I. 168 To regulate his out-goes.. to order and frugality. **1757** FRANKLIN *Ess.* Wks. 1846 II. 98 'The Indies have not made Spain rich, because her outgoes are greater than her incomes. **1860** EMERSON *Cond. Life*, *Wealth* Wks. (Bohn) II. 358 The secret of success lies..in the relation of income to outgo. **1895** SIR W. HARCOURT *Sp.* 22 May, Grow as the income or the intake may, the outgo and the waste are always greater.

2. The action of going out; efflux, outflow.

1858 W. ARNOT *Laws fr. Heaven* II. xvii. 142 [Anger] hurts, in its outgo, all who lie within its reach. **1878** FOSTER *Phys.* I. iv. (ed. 2) 108 In a system of elastic tubes.. the out-go being as easy.. as the income. **1882-3** SCHAFF *Encycl. Relig. Knowl.* I. 33 The spontaneous outgo of the affections.

3. Outward product; issue, outcome.

1870 W. URWICK tr. *Bleek's Introd. N. Test.* II. 175 Their scorn was the outgo of the same frivolous mind.

4. Outlet, means of egress.

1869 S. BOWLES *Our New West* i. 26 The great Salt Lake of Utah..has no visible outgo, though richly fed from various quarters. **1880** S. S. HELLYER *Plumber & Sanit. Ho.* 15 A square-pipe trap, with a round outgo.

outgo (aʊt'gəʊ), *v.* [OUT- 14, 18, 17.]

†1. *intr.* To go out, go forth. *Obs.* except *poetic*.

In OE. and ME. usually two words, exc. when imitating L. *exire*; in later use only where modern usage would allow *out go* in two words as a prosodic inversion of *go out*.

c **825** *Vesp. Psalter* xviii. [xix.] 5 In alle eorðan uteode sweg heara. **971** *Blickl. Hom.* 9 Drihten..of þæm uteode. *c* **1250** *O. Kent. Serm.* in *O.E. Misc.* 33 þet on goodman was þat ferst uut yede bi þe Moreghen for to here werkmen. *c* **1250** *Gen. & Ex.* 3076 Quile ben ðo ðe sulen ut gon? *a* **1300** *E.E. Psalter* xliii. 10 [xliv. 9] In our mightes, Gud, noght sal tou out ga. *c* **1385** CHAUCER *L.G.W.* 637 *Cleopatra*, With grysely soun out goth the grete gonne. **1530** PALSGR. 650/2, I outgo, I go out of the waye, *Je forvoye*. **1579** SPENSER *Sheph. Cal.* May 20, I sawe a shole of shepheardes outgoe. *a* **1635** CORBET *Poems* (1807) 15 Out-went the townsmen all in starch. **1899** P. H. WICKSTEED tr. *Dante's Paradiso* xlii. 161 That living Light which so outgoeth from its Source that it departeth not therefrom. **1905** *Outlook* 4 Nov. 629/1 So you, dear Frank, were last of those 'To whom a tender thought outgoes.

2. *trans.* To outstrip in going; to go faster than, pass; to outdistance. *arch.*

1530 PALSGR. 650/2 Though thou be goynge an hour afore me, yet I wyll out go the. **1596** SPENSER *F.Q.* v. viii. 4 Yet fled she fast and both them farre outwent. **1649** LOVELACE *Poems* (1864) 93 What terror 'tis t' outgo and be outgon. **1678** BUNYAN *Pilgr.* I. 164 Shall we talk further with him? or out-go him at present? **1742** FIELDING *J. Andrews* II. ii, It generally happens that he on horseback outgoes him on foot. **1778** *Eng. Gazetteer* (ed. 2) s.v. *Workington*, Horses, which, changing often, travel day and night with-out intermission, and, as they say, out-go the post.

3. To go beyond (a point, bounds, etc.); to exceed or surpass; to excel, outstrip, outdo.

1553 T. WILSON *Rhet.* 64 b, Wo be to that realme where might outgoeth right. **1579** SPENSER *Sheph. Cal.* Apr. 16 His wonted songs, wherein he all outwent. **1627** MILTON *Vac. Exerc.* 79 In worth and excellence he shall out-go them. **1799** A. HAMILTON *Lett.* in *Washington's Writ.* (1893) XIV. 178 *note*, I do not think it expedient to outgo our supply of clothing. **1885-94** R. BRIDGES *Eros & Psyche* Sept. xxiii, Such sorrow as outwent The utmost pain of other punishment.

†4. To pass, go through, spend (time). *Obs.*

1594 SPENSER *Amoretti* lx, One yeare.. The which doth longer unto me appeare, Then al those fourty which my life out-went. *a* **1613** OVERBURY *A Wife*, etc. (1638) 275, I have once in my life out-gone night at Sea.

†5. 'To circumvent, to overreach' (J.). *Obs.*